MAP SCHEME
OF THE
SENSORY DISTRIBUTION
OF THE
FIFTH NERVE (TRIGEMINUS)
WITH ITS
GANGLIA AND CONNECTIONS
BY
L. HEMINGTON PEGLER.

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SENSOR

FIFTH N

GANGLIA

AP-SCHEME OF THE
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OF THE
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WITH ITS
A AND CONNECTIONS

L. HE MINGTON PEGLER, M.D.
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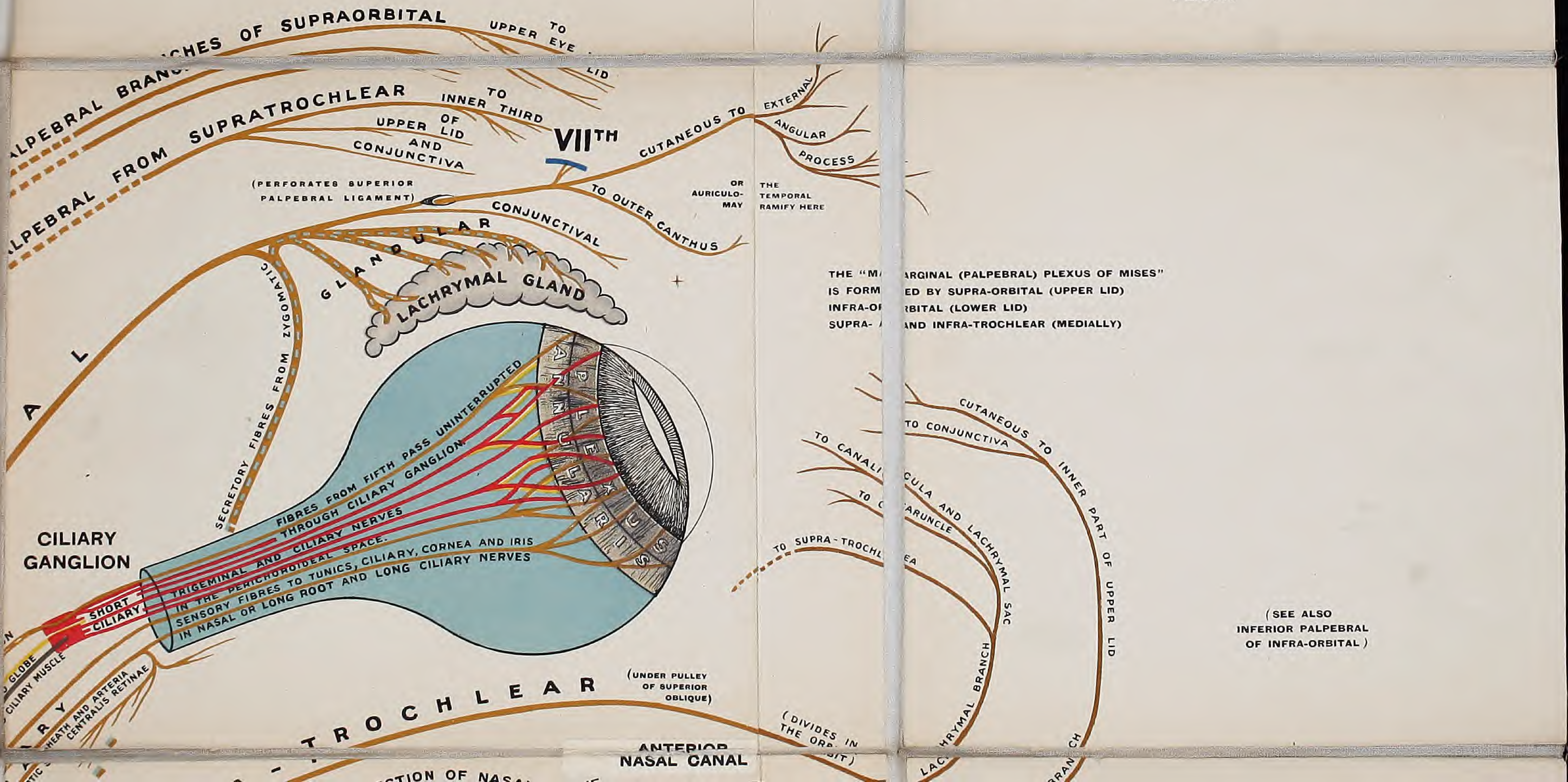
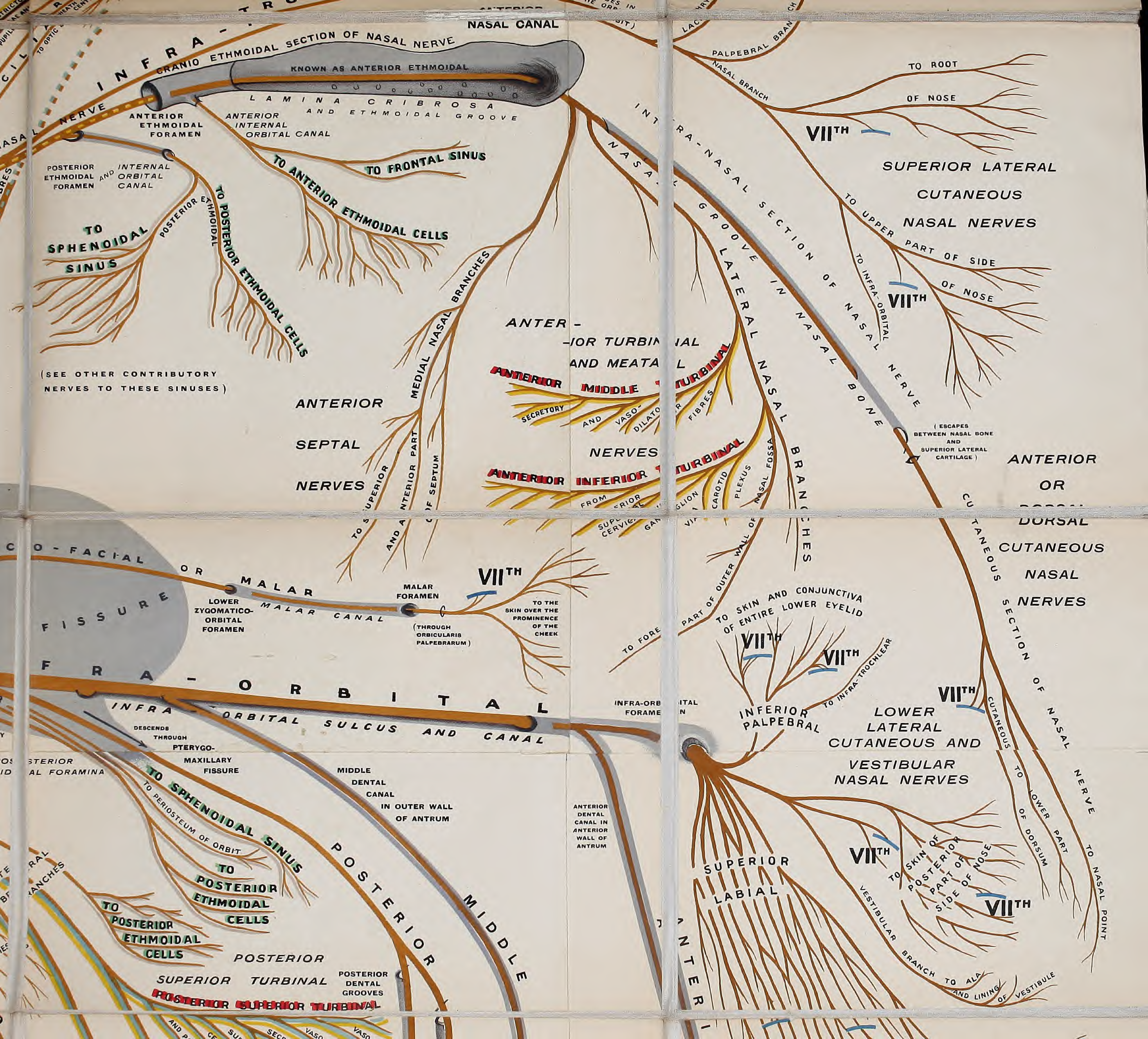


CHES OF SUPRAORBITAL
LPEBRAL BRAN
UPPER EYE LID
TO
SUPRATROCHLEAR
TO INNER THIRD OF UPPER LID AND CONJUNCTIVA
LPEBRAL FROM
LPEBRAL
VII TH
CUTANEOUS TO EXTERNAL ANGULAR PROCESS
(PERFORATES SUPERIOR PALPEBRAL LIGAMENT)
TO OUTER CANTHUS
CONJUNCTIVAL
OR AURICULO- MAY
THE TEMPORAL RAMIFY HERE
GLANDULAR
LACHRYMAL GLAND
SECRETORY FIBRES FROM ZYGOMATIC
A L
THE "M ARGINAL (PALPEBRAL) PLEXUS OF MISES"
IS FORM ED BY SUPRA-ORBITAL (UPPER LID)
INFRA-OR BITAL (LOWER LID)
SUPRA- AND INFRA-TROCHLEAR (MEDIALLY)
APPENDIX
CILIARY GANGLION
SHORT CILIARY
FIBRES FROM FIFTH PASS UNINTERRUPTED THROUGH CILIARY GANGLION.
TRIGEMINAL AND CILIARY NERVES IN THE PERICHOROIDEAL SPACE.
SENSORY FIBRES TO TUNICS, CILIARY, CORNEA AND IRIS IN NASAL OR LONG ROOT AND LONG CILIARY NERVES
GLOBE
CILIARY MUSCLE
SHEATH AND ARTERIA CENTRALIS RETINAE
CUTANEOUS TO INNER PART OF UPPER LID
TO CONJUNCTIVA
TO CANALICULA AND LACHRYMAL SAC
TO CARUNCLE
LACHRYMAL BRANCH
TO SUPRA-TROCHLEA
(SEE ALSO INFERIOR PALPEBRAL OF INFRA-ORBITAL)
TROCHLEAR
(UNDER PULLEY OF SUPERIOR OBLIQUE)
(DIVIDES IN THE ORBIT)
ANTERIOR NASAL CANAL
CTION OF NASA
BRANCH

COLOUR SCHEME

NERVE.		
IIIRD	MOTOR OCULI	SEPIA
IVTH	TROCHLEARIS	SAGE GREEN
VTH	TRIGEMINUS	YELLOW OCHRE
VTH	MOTOR BRANCHES	ASH GREY
VITH	ABDUCENS	BLUE GREY
VIITH	FACIAL MOTOR	DARK BLUE
VIITH	PARS INTERMEDIA	LIGHT BLUE
VIIITH	AUDITORY	LIGHT PURPLE

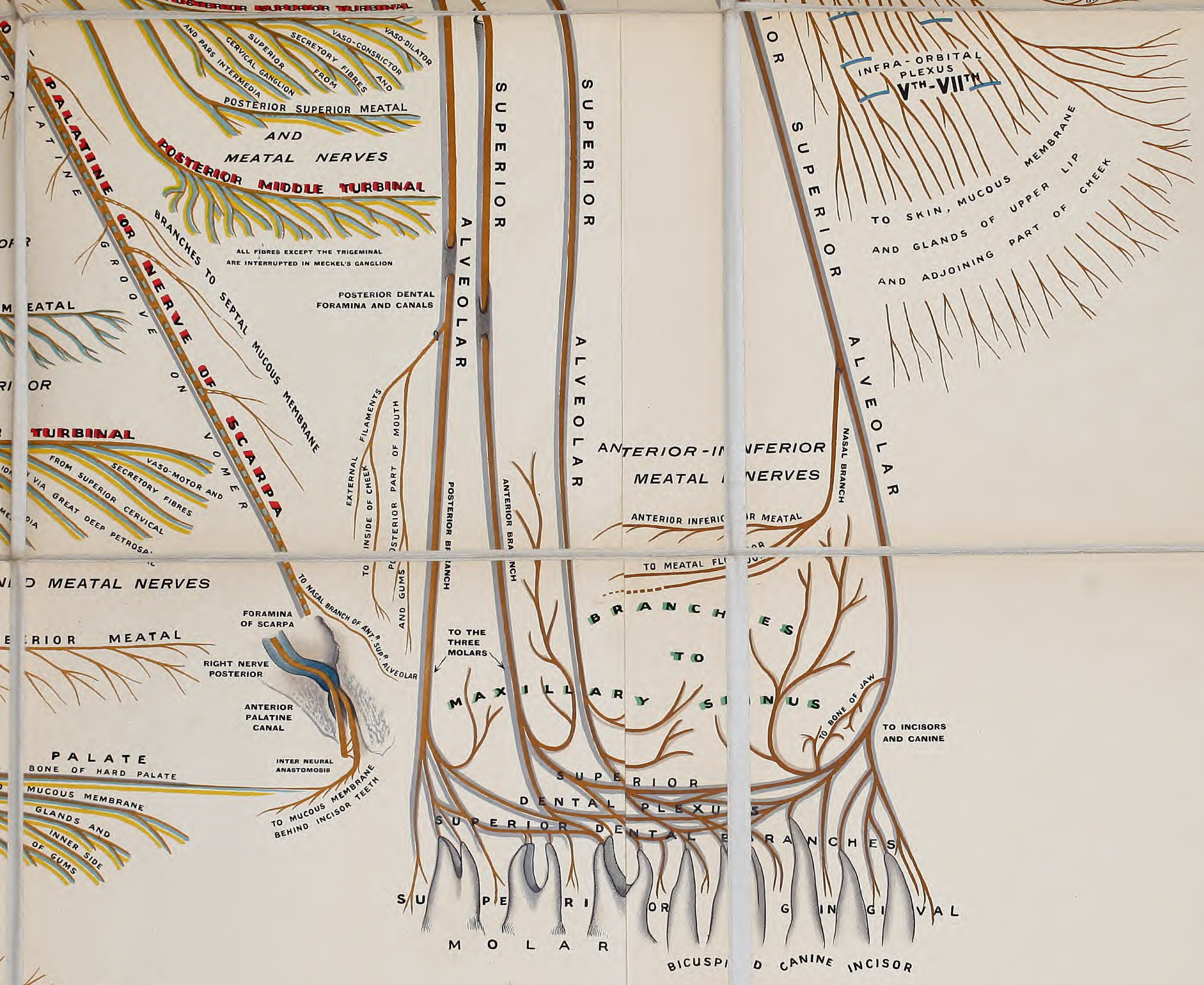

INFRA-TROCHLEAR
NASAL CANAL
CRANIO ETHMOIDAL SECTION OF NASAL NERVE
KNOWN AS ANTERIOR ETHMOIDAL
LAMINA CRIBROSA AND ETHMOIDAL GROOVE
NASAL NERVE
ANTERIOR ETHMOIDAL FORAMEN
ANTERIOR INTERNAL ORBITAL CANAL
POSTERIOR ETHMOIDAL FORAMEN
AND
INTERNAL ORBITAL CANAL
TO FRONTAL SINUS
TO ANTERIOR ETHMOIDAL CELLS
TO SPHENOIDAL SINUS
POSTERIOR ETHMOIDAL
TO POSTERIOR ETHMOIDAL CELLS
(SEE OTHER CONTRIBUTORY NERVES TO THESE SINUSES)
MEDIAL NASAL BRANCHES
ANTERIOR SEPTAL NERVES
TO SUPERIOR AND ANTERIOR PART OF SEPTUM
ANTERIOR TURBINAL AND MEATAL NERVES
ANTERIOR MIDDLE TURBINAL
SECRETORY AND VASO-DILATOR FIBRES
ANTERIOR INFERIOR TURBINAL
FROM SUPERIOR CERVICAL GANGLION VIA CAROTID PLEXUS
NASAL FOSSA
LATERAL NASAL BRANCHES
TO FORE PART OF OUTER WALL OF NASAL FOSSA
PALPEBRAL BRANCH
NASAL BRANCH
TO ROOT OF NOSE
VIITH
SUPERIOR LATERAL CUTANEOUS NASAL NERVES
INTRA-NASAL SECTION OF NASAL NERVE
GROOVE IN NASAL BONE
TO UPPER PART OF SIDE OF NOSE
TO INFRA-ORBITAL NASAL
VIITH
(ESCAPES BETWEEN NASAL BONE AND SUPERIOR LATERAL CARTILAGE)
ANTERIOR OR DORSAL CUTANEOUS NASAL NERVES
CUTANEOUS SECTION OF NASAL NERVE
ZYGOMATICO-FACIAL OR MALAR
FISSURE
LOWER ZYGOMATICO-ORBITAL FORAMEN
MALAR CANAL
MALAR FORAMEN
(THROUGH ORBICULARIS PALPEBRARUM)
VIITH
TO THE SKIN OVER THE PROMINENCE OF THE CHEEK
TO SKIN AND CONJUNCTIVA OF ENTIRE LOWER EYELID
VIITH
VIITH
TO INFRA-TROCHLEAR
INFERIOR PALPEBRAL
VIITH
LOWER LATERAL CUTANEOUS AND VESTIBULAR NASAL NERVES
CUTANEOUS
INFRA-ORBITAL
INFRA-ORBITAL SULCUS AND CANAL
INFRA-ORBITAL FORAMEN
DESCENDS THROUGH PTERYGO-MAXILLARY FISSURE
POSTERIOR ETHMOIDAL FORAMINA
TO SPHENOIDAL SINUS
TO PERIOSTEUM OF ORBIT
TO POSTERIOR ETHMOIDAL CELLS
TO POSTERIOR ETHMOIDAL CELLS
MIDDLE DENTAL CANAL IN OUTER WALL OF ANTRUM
POSTERIOR
MIDDLE
ANTERIOR DENTAL CANAL IN ANTERIOR WALL OF ANTRUM
ANTERIOR
SUPERIOR LABIAL
VIITH
TO SKIN OF POSTERIOR PART OF SIDE OF NOSE
VIITH
TO LOWER PART OF DORSUM
TO NASAL POINT
VESTIBULAR BRANCH TO ALA AND LINING OF VESTIBULE
POSTERIOR SUPERIOR TURBINAL
POSTERIOR DENTAL GROOVES
POSTERIOR SUPERIOR TURBINAL
LATERAL BRANCHES

VIIITH AUDITORY LIGHT PURPLE
IXTH GLOSSOPHARYNGEAL PURPLE
XTH VAGUS BRICK RED
XIITH HYPOGLOSSAL PALE PINK
CERVICAL NERVES DARK GREEN
GANGLIA OF FIFTH VERMILION
SYMPATHETIC YELLOW
VIITH AND PARS INTERMEDIA
VTH AND PARS INTERMEDIA
VTH AND IXTH
VTH AND SYMPATHETIC
NERVE IN BONY CANAL OR GROOVE
NERVES BETWEEN BONE AND MEMBRANE
VIITH
AQUEDUCTUS FALLOPII
HIATUS FALLOPII
TO STAPEDIUS
FENESTRA VESTIBULI
CHORDA TYMPANI
FENESTRA COCHLEAE
TO MASTOID CELLS
TYMPANIC NERVE AND PLEXUS
TO TYMPANUM
TO EUSTACHIAN TUBE
CAROTICO-TYMPANIC
FACIAL
VII-X
TO AURICULAR
VIITH-IXTH
TO GLOSSO-PHARYNGEAL
PETROUS GANGLION OF IXTH
JUGULAR OR ROOT GANGLION OF VAGUS AND GANGLION OF TRUNK
XTH
JUGULAR BR.
PHARYNGEAL
SUPERIOR LARYNGEAL
SUPERIOR CERVICAL GANGLION
SUPERIOR CARDIAC
TO PHARYNGEAL PLEXUS
GREY RAMUS
MOTOR ROOT
SENSORY ROOT OF 1ST CERVICAL
GANGLION
TO SYPATHETIC ON INTERNAL MAXILLARY
SUPERFICIAL PETROSAL
SECRETORY ROOT
TO TENSOR TYMPANI
OTIC GANGLION
SMALL DEEP PETROSAL
TO CHORDA TYMPANI
TO SPINOUS
MOTOR-SENSORY ROOT FROM INTERNAL PTERYGOID
SPHENOIDAL
TO VIDIAN
TO AURICULO-TEMPORAL
SYMPATHETIC ROOT FROM MENINGEAL PLEXUS
TO TENSOR PALATI
TO BUCCAL
EXTL SUPL PETROSAL
GREAT DEEP PETROSAL
INTERNAL CAROTID PLEXUS
MIDDLE MENINGEAL ARTERY AND PLEXUS
TO TEMPORO-MAXILLARY ARTICULATION
TO INFERIOR ALVEOLAR
AURICULO TEMPORAL
XTH
TO UPPER AND BACK PART OF PINNA
AURICULAR OF VAGUS
NERVE OF ARNOLD
TO LOWER TWO THIRDS OF BACK PART OF PINNA
TO UPPER AND FORE PART OF PINNA
SUPERIOR ANTERIOR AURICULAR
TO ASCENDING LIMB AND CRUS OF HELIX
MASTOID BRANCH
AURICULAR BRANCH
GREAT AURICULAR
INFERIOR ANTERIOR AURICULAR
TO TRAGUS
SUPERIOR EXTERNAL MEATAL
TO ROOF OF MEATUS
(PASSES BETWEEN OSSEOUS AND CARTILAGINOUS PARTS OF MEATUS)
TO MEMBRANA TYMPANI
XTH
TWIG TO MEMBRANA TYMPANI
XTH
TO LOWER AND BACK PART OF MEATUS
TO ANTERIOR WALL OF MEATUS
INFERIOR EXTERNAL MEATAL
OCCASIONAL TO LOBULE
BRANCHES TO PAROTID GLAND WITH SECRETORY FIBRES FROM IXTH
TEMPORO-FACIAL
FACIAL VIITH
BRANCHES TO FACIAL
TO PAROTID
MASSETERIC AND BUCCAL REGIONS
GREAT AURICULAR FROM CERVICAL PLEXUS
INFERIOR DENTAL FORAMEN
LONG BUCCAL
EXTERNAL PTERYGOID
INTERNAL PTERYGOID
(PASSES BETWEEN THE TWO HEADS OF EXTERNAL PTERYGOID)
CHORDA TYMPANI
INFERIOR ALVEOLAR
LINGUAL
RAMIFIES TO EXTERNAL ANGULAR PROCESS
CUTANEOUS BRANCHES
MUCOUS LINING AS FAR AS ANGLE OF MOUTH
TO CHEEK
BUCCAL PLEXUS VTH-VIITH
1
2
3
CUTANEOUS BRANCHES OF AURICULO-TEMPORAL
(1) UPWARDS OVER THE ZYGOMA
(2) FORWARDS TO ANGLE OF MOUTH
(3) DOWNWARDS TOWARDS THE CHIN
TO INFERIOR ALVEOLAR
VASO-DILATOR & SECRETORY FIBRES IN CHORDA TYMPANI
BRANCHES TO ISTHMUS OF FAUCES
TO POSTERIOR PART OF BUCCAL CAVITY
TONSILLAR BRANCH
SUBMAXILLARY GANGLION
SYMPATHETIC ROOT
SECRETORY & VASO MOTOR
FACIAL PLEXUS OR FACIAL ARTERY
SUBMAXILLARY GLAND
TO FLOOR OF MOUTH
TO WHARTON'S DUCT
TO XIITH
SUBLINGUAL
SUBLINGUAL GLAND
SUBLINGUAL GANGLION
TO TONSIL
CIRCULUS TONSILARIS FROM IXTH
COMMUNICATING WITH XIITH HYPOGLOSSAL
GUSTATORY FIBRES IN CHORDA TYMPANI
IXTH FROM GLOSSOPHARYNGEAL
TO PAPILLAE OF ANTERIOR 2/3 OF TONGUE
INFERIOR ALVEOLAR
INFERIOR MYLO-HYOID IN MYLO-HYOID GROOVE
DIGASTRIC BR.
MOLAR
BICUSPID CANINE INCISOR
INFERIOR GINGIVAL
INFERIOR DENTAL PLEXUS
DENTAL CANAL
INCISIVE
INFERIOR LABIAL SET
MENTAL PLEXUS
TO THE INNER AND OUTER SURFACES OF THE LOWER LIP AND CHIN
TO UPPER PART
TO NASOPHARYNX
TO MOUTH OF EUSTACHIAN TUBE
TO POSTERIOR NARIS
POSTERIOR OR SMALL PALATINE
EXTERNAL OR MIDDLE (LEAST) PALATINE
ANTERIOR OR GREAT PALATINE
LESSER POSTERIOR PALATINE FORAMEN
ACCESSORY PALATINE FORAMEN
TO UVULA
TO MUCOUS MEMBRANE AND GLANDS OF SOFT PALATE
SECRETORY AND VASO-MOTOR FIBRES PASSING TO MUCOUS MEMBRANE OF MOUTH AND SOFT PALATE FROM PARS INTERMEDIA AND SYMPATHETIC ARE INTERRUPTED IN SPHENOPALATINE GANGLION
GREATER OR POSTERIOR
PALATO-MAXILLARY FORAMEN
TO HARD
GROOVING
FILAMENTS TO SOFT PALATE
(SEE ALSO SEPTAL OF VIDIAN)
NASO-PALATINE
POSTERIOR
POSTERIOR MIDDLE MEATUS
POSTERIOR INFERIOR
BRANCH TO NASAL DUCT
GANGLION VIA AND PARS INTERMEDIA
TURBINAL AND
POSTERIOR INFERIOR

SENSORY ROOT OF FIFTH NERVE

THIS DRAWING IS AN EPITOME OF THE LARGE MAP, AND ALSO REPRESENTS THE SENSORY DISTRIBUTION OF THE OCCIPITAL NERVES WHICH, WITH THE FIFTH AND THE AURICULAR BRANCHES OF THE CERVICAL PLEXUS AND VAGUS, COMPLETE THE INNERVATION OF THE SCALP.

TO ILLUSTRATE THE THEORY OF REFERRED PAIN, IT TRACES BACK THE SENSORY ROOT OF THE FIFTH FROM THE GASSERIAN GANGLION TO ITS NUCLEUS IN THE PONS VAROLII AND MEDULLA OBLONGATA. THIS SENSORY NUCLEUS EXTENDS FROM THE KNEE-SHAPED



B

CUTANEOUS NERVE AREAS OF HEAD AND NECK

CERVICAL NERVES

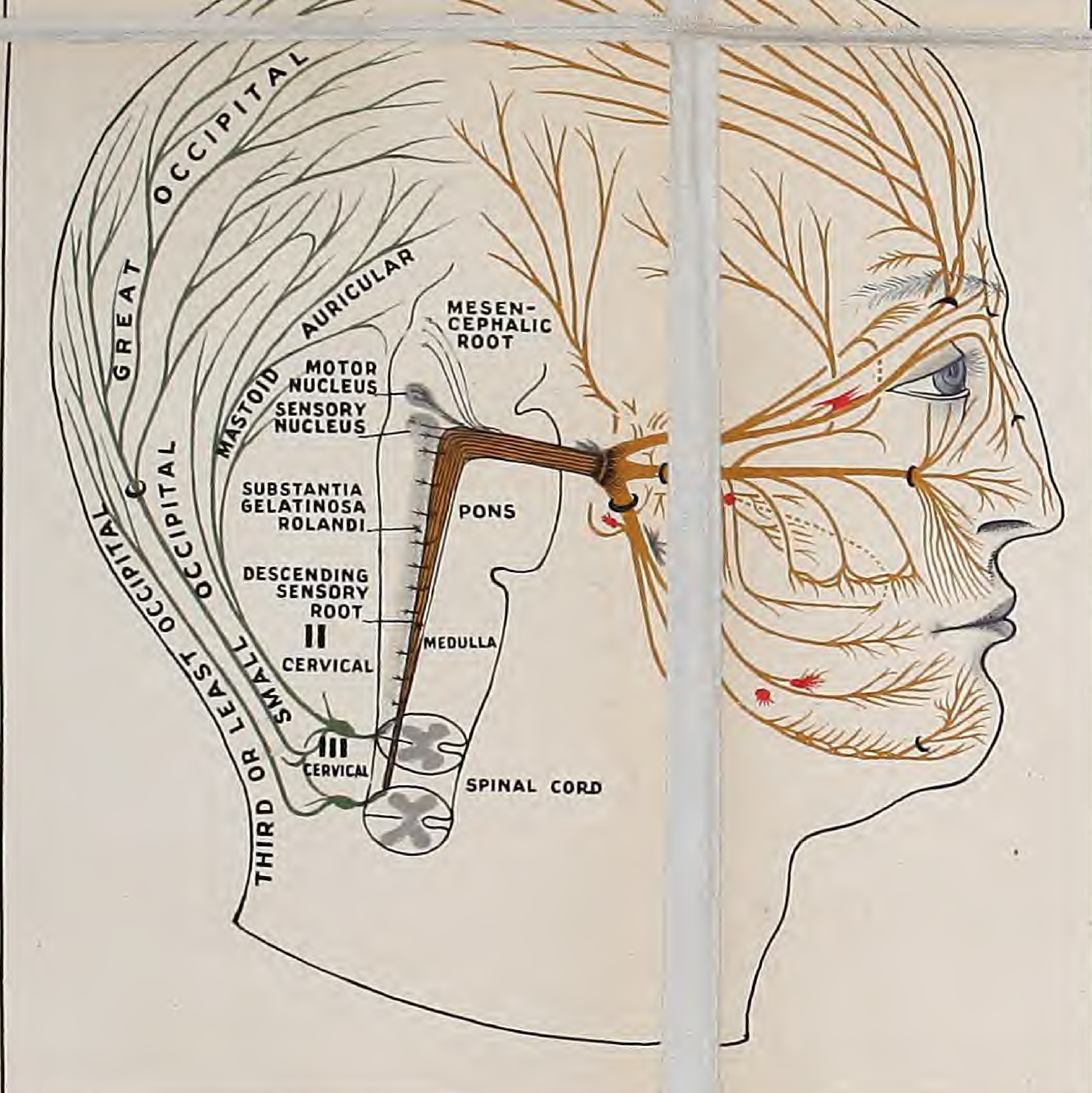
TRIGEMINAL

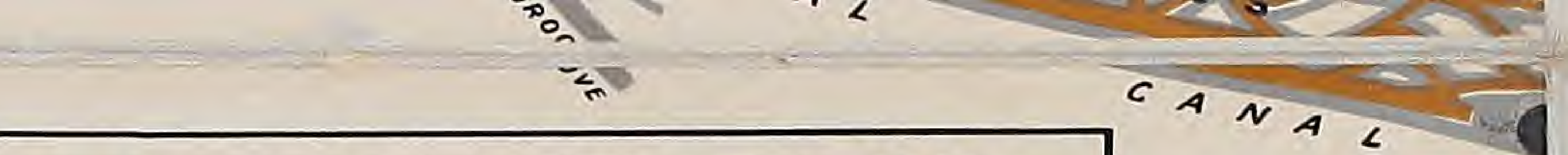
FIFTH FROM THE GASSERIAN GANGLION TO ITS NUCLEUS IN THE PONS VAROLII AND MEDULLA OBLONGATA. THIS SENSORY NUCLEUS EXTENDS FROM THE KNEE-SHAPED END IN THE PONS TO THE SECOND OR THIRD CERVICAL SEGMENT OF THE SPINAL CORD; IT CONSISTS OF THE SUBSTANTIA GELATINOSA OF ROLANDO WHICH IS CONTINUOUS IN THE SPINAL CORD WITH THE MASS OF GREY MATTER IN THE TIP OF THE POSTERIOR HORN, IN WHICH THE POSTERIOR ROOTS OF THE SPINAL NERVES END.

OWING TO THE TERMINATION IN THIS EXTENSIVE NUCLEUS OF CERTAIN NASO-CILIARY, MAXILLARY, AND MANDIBULAR FIBRES AT POINTS WHERE THEY COME INTO CLOSE RELATION WITH THE CENTRAL TERMINALS OF OTHER TRIGEMINAL FIBRES INNERVATING THE FOREHEAD, TEMPLE OR OTHER PART, PAINFUL STIMULI ARISING IN THE NOSE OR ACCESSORY SINUSES, EYE, TEETH, OR EAR, WHICH ARE SUPPLIED BY THE FIRST NAMED, MAY BE 'REFERRED' AS PAIN TO THE TEMPLE, FOREHEAD, OR OTHER PART.

THE FREQUENT 'REFERENCE' OF PAINFUL STIMULI—NASAL, OCULAR, DENTAL OR AURAL,—TO THE *OCCIPITAL* REGION, IS EXPLAINED ANATOMICALLY BY THE CENTRAL CONTIGUITY OF CERTAIN OTHER OF THESE NASO-CILIARY OR MAXILLARY AFFERENT TERMINALS TO THOSE OF THE UPPER THREE CERVICAL ROOTS IN THE DESCENDING TRIGEMINAL NUCLEUS. THE PERIPHERAL DISTRIBUTION OF THESE CERVICAL ROOTS LIES, AS THE DRAWING SHOWS, IN THE BACK OF THE HEAD AND NECK THROUGH THEIR OCCIPITAL BRANCHES.

N.B.—FOR A TABULATED ARRANGEMENT OF THE NERVES IN THE MAP AND IN THESE INSETS, WITH SEPARATE ANATOMICAL AND PHYSIOLOGICAL ANALYSES FOR THE EYE, EAR, AND NOSE, WITH ADDITIONAL NOTES, SEE THE COMPANION TABLES PUBLISHED IN CONJUNCTION HEREWITH.



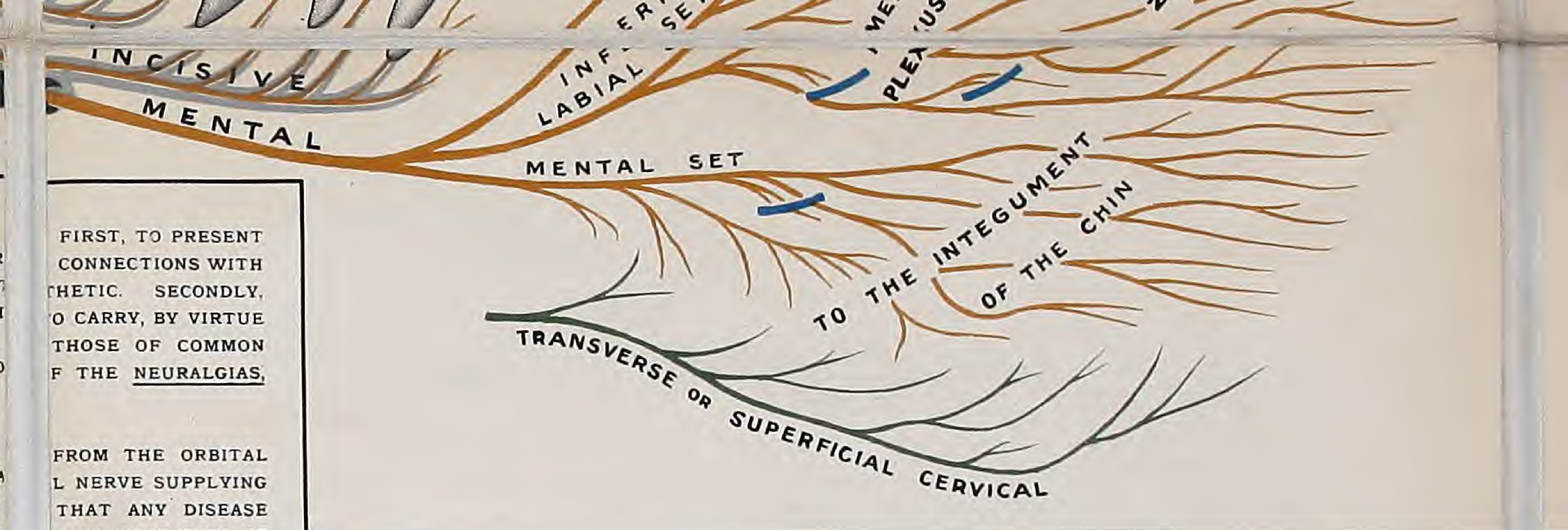


EXPLANATORY NOTE TO MAP.

THIS SCHEME OF THE FIFTH OR TRIGEMINAL NERVE IS DESIGNED TO SERVE A THREE-FOLD PURPOSE. FIRST, TO PRESENT IN MAP FORM, ALL ITS SENSORY BRANCHES FROM THE GASSERIAN GANGLION TO THE PERIPHERY, THEIR CONNECTIONS WITH OTHER CRANIAL NERVES, WITH THE UPPER THREE CERVICAL NERVES, AND WITH THE CERVICAL SYMPATHETIC. SECONDLY, TO DEMONSTRATE THE COMPLEX FUNCTIONS OF SUCH BRANCHES OF THE FIFTH NERVE AS ARE KNOWN TO CARRY, BY VIRTUE OF THESE OUTSIDE CONNECTIONS, SECRETORY, VASOMOTOR, OR MOTOR FIBRES IN ADDITION TO THOSE OF COMMON SENSIBILITY. THIRDLY, TO ASSIST THE STUDENT IN UNDERSTANDING THE ANATOMICAL BASIS (1) OF THE NEURALGIAS, AND (2) OF REFERRED PAINS.

(1) THE MAP SHOWS, FOR INSTANCE, THAT THE FIBRES OF THE NASO-CILIARY NERVE ARISING FROM THE ORBITAL AND NASAL REGIONS, ARE BOUND UP IN THE OPHTHALMIC DIVISION WITH THE FIBRES OF THE FRONTAL NERVE SUPPLYING THE SUPRAORBITAL AND FRONTAL REGIONS. NOW IT IS A KNOWN CONSEQUENCE OF THIS FACT THAT ANY DISEASE INVOLVING THE NASO-CILIARY NERVE MAY PRODUCE NEURALGIA IN THE BROW OR FOREHEAD BY THE RADIATION OF PAIN ALONG THE PATH OF THE SUPRAORBITAL NERVE WITH WHICH IT IS THUS ASSOCIATED. ANOTHER INSTANCE IS THE NEURALGIA SET UP IN THE EAR BY CARIOUS TEETH IN EITHER JAW, OWING TO THE BINDING UP OF THE FIBRES OF THE INFERIOR ALVEOLAR NERVE WITH THOSE OF THE AURICULO-TEMPORAL IN THE MANDIBULAR DIVISION.

(2) THE MAP ALSO SHOWS HOW 'REFERRED PAIN' (OF A DULL ACHING CHARACTER AND OTHERWISE DISTINGUISHABLE FROM NEURALGIA) MAY BE TRACED FROM ITS TRUE SOURCE OR SITE OF 'EXCITATION' TO A SITE OF 'REFERENCE' OR 'ASCRIPTION' IN A PART OF THE HEAD REMOTE FROM ITS SOURCE. CERTAIN BRANCHES DISTRIBUTED TO THE NASAL SEPTUM AND TURBINATES WHICH ARE FAMILIARLY KNOWN AS CONDUCTORS OF STIMULI FROM THESE SITES OF EXCITATION IN THE NOSE, ARE SHADED RED 🟥 IN THE LETTERING, WHILE THE TEMPORAL AND FRONTAL BRANCHES WHICH ARE DISTRIBUTED OVER THE AREAS TO WHICH THE PAIN ARISING IN THESE SITES IS COMMONLY REFERRED, ARE SHADED BLUE. A THEORY FOR THE EXPLANATION OF THIS PHENOMENON OF 'MIS-REFERENCE' OF PAIN IS GIVEN IN THE DESCRIPTION OF THE SMALL INSET DRAWING,—**A**; OTHER INSTANCES OF REFERRED PAIN MAY BE TRACED BY THE AID OF THE SCHEME, *E.G.*, FRONTAL HEADACHE DUE TO EYE-STRAIN, OR PAIN IN THE EAR DUE TO IRRITATION OF THE SUPERIOR LARYNGEAL BRANCH OF THE VAGUS.


INCISIVE
MENTAL
INF LABIAL
MENTAL SET
PLEXUS
TO THE INTEGUMENT OF THE CHIN
TRANSVERSE OR SUPERFICIAL CERVICAL

THE MAP IS NOT DRAWN TO SCALE; THE EXIGENCIES OF A CLEAR AND COMPREHENSIVE NOMENCLATURE HA TICALLY DOMINATED THE DESIGN AS IT PROCEEDED. IN COMMON WITH ALL SIMILAR SCHEMES, THE NERVE A AP THOUGH SPREAD OUT LIKE A SPECIMEN MOUNTED FOR THE CABINET, AND BRANCHES WHICH DESCEND IN TE THROUGH THE SAME CORONAL PLANE ARE UNAVOIDABLY SEGREGATED TO SAVE CROSSINGS AND ENTANGLEME NT OF THE DRAWBACKS OF THIS SEGREGATION OF NERVES, *E.G.*, THE NASAL BRANCHES OF THE OPHTHALMIC DIV IS THE NEIGHBOURING BRANCHES OF THE MAXILLARY DIVISION ARE MITIGATED, IT IS HOPED, BY THE REPRESENTAT IC BONY GROOVES, CANALS, AND FORAMINA, AS WELL AS OF CERTAIN FISSURES AND FOSSÆ, THROUGH WHICH TH ES PASS. THE NERVES OF THE ACCESSORY SINUSES, BEING ALSO FOR THE SAME REASON DISSOCIATED, H AT LETTERING EMPHASISED BY GREEN SHADING. THE FACIAL NERVE ANASTOMOSES ARE DARK BLUE.

AUTHORS CONSULTED.—Morris, Ed. 1907; Quain, 1909; Gray, 1909; Cunningham, 1909; ditto, Practical Anatomy, Ed. 5. 1912; Gerrish 1907; Spalteholz, 1903; Poirier and Charpy, 1904. Tome III. "Nerfs craniens;" by Cuneo, who has been followed chiefly in the physiological part, "Hirschfeld and Leveillé," and "Bourgerie and Jacob." Flower's Nerves, Edinger. Nervose Zentralorgane 8th. Ed. 1911 Frohse, Rauber, Testut, etc.

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CERVICAL NERVES

POSTERIOR PRIMARY DIVISIONS.

(DEMARCATED BY THICK BROKEN LINE).

- - - - - - - - - - - -

II. CERVICAL.
GREAT OCCIPITAL.

III. CERVICAL.
THIRD OCCIPITAL.

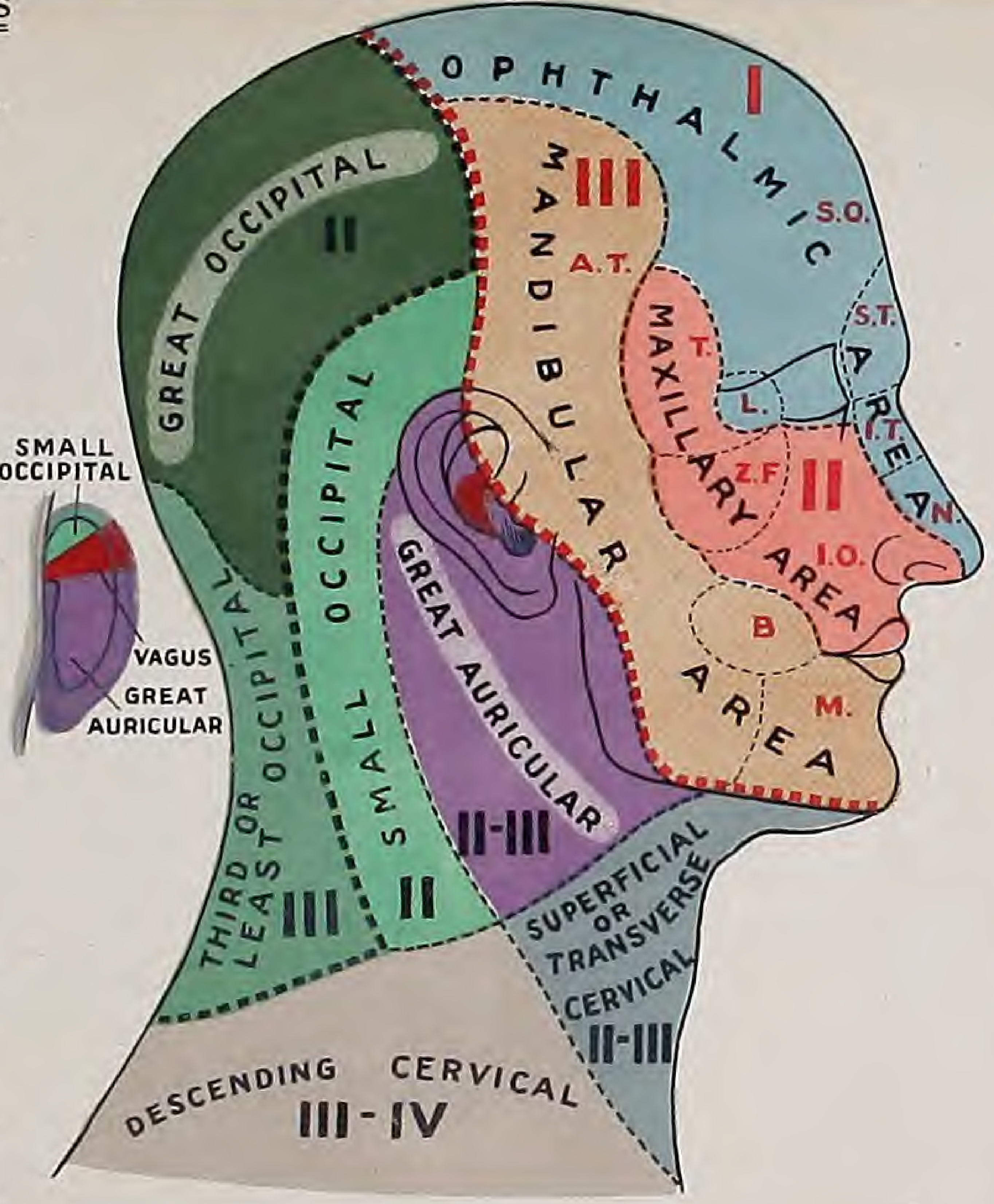
ANTERIOR PRIMARY DIVISIONS.

(CERVICAL PLEXUS).

II. CERVICAL.
SMALL OCCIPITAL.

II. AND III. CERVICAL.
GREAT AURICULAR.
TRANSVERSE CERVICAL.

III. AND IV. CERVICAL.
DESCENDING CERVICAL.



TRIGEMINAL NERVE

(DEMARCATED BY DOTTED RED LINE).

- - - - - - - - - - - -

SUPRA-ORBITAL.
AURICULO-TEMPORAL.
SUPRA-TROCHLEAR.
TEMPORAL.
LACHRYMAL.
INFRA-TROCHLEAR.
ZYGOMATICO-FACIAL
(MALAR).
NASAL.
INFRA-ORBITAL.
BUCCAL.
MENTAL.

ADAPTED FROM MORRIS'
"TREATISE O N ANATOMY,"
FOURTH EDITION.

ANALYTICAL TABLES
OF THE
ANATOMY AND PHYSIOLOGY
OF THE
FIFTH CRANIAL OR TRIGEMINAL NERVE
AND OF ITS
GANGLIA AND CONNECTIONS

BEING A COMPENDIUM OF THE MAP-SCHEME OF THIS NERVE

BY

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LONDON: BAILLIÈRE, TINDALL AND COX
8, HENRIETTA STREET, COVENT GARDEN
1913
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PREFACE

This Map-Scheme of the Fifth Cranial Nerve and its connections was originally designed to illustrate a lecture given by the writer in London upon referred pains in the head. It has since been much altered and enlarged, two insets have been added, and explanatory notes have been affixed. The functions of the nerves are indicated in the map in respect of all the more important branches to the nose, eye, tongue, palate, and secreting glands, such paths having been selected as have been most successfully investigated. The statements thus embodied are also tabulated in the analyses included herewith. To the student this graphic presentation of the complex trigeminal system is intended to be useful in the course of his reading and dissections. To the clinician it should furnish the clues required for following up the tracks along which pain excited in one part of the head may be referred to a distant part. It should also aid him in understanding how, through their mutual nervous connections, disease in one organ such as the nose or ear may produce symptoms which seriously affect another, as, for instance, the eye or the teeth.

The writer hopes that by rendering a study of this important nerve more easy or attractive, the map-scheme will enable many practitioners to attain a closer acquaintance with its anatomy and physiology, the surest road to success in the treatment of its morbid states.

Finally, he has a pleasing duty to perform in expressing his indebtedness to those gentlemen who have placed him under obligation in the progress of his work. Professor Thane, of University College, Dr. David Waterston, Professor of Anatomy at King's College, and Dr. John Cameron, Lecturer on Anatomy at Middlesex Hospital Medical School, have rendered him kindly assistance on difficult points; Dr. Waterston insuring the accuracy of the tables by passing them carefully under review, and Dr. Cameron giving him access to recent dissections of the fifth nerve. To Dr. Gordon Holmes the author feels himself most deeply indebted for information and advice in many directions, but especially with reference to the physiological part, and to the drawing and description of the Inset A (Roots of the Fifth Nerve), which is such an important addition to the scheme.

An inset for skin areas was inserted under the suggestion of Dr. James Mackenzie, who, as well as Professors Arthur Keith, Johnson Symington, and other experts, examined the map when it was approaching completion. In January, 1913, it was exhibited before the Anatomical Society of Great Britain.

L. H. P.

Harley Street, W.,
July, 1913.

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INTRODUCTORY NOTE UPON THE NOMENCLATURE ADOPTED IN THE MAP CONCERNING THE NASAL NERVES

THE *General Nomenclature* of the map has been kept as much as possible in line with the latest edition of Quain's 'Elements,' edition 1909, and the changes suggested in the B.N.A. (Basle Anatomical Nomenclature) have been largely utilized. A departure has been made only in the instance of the nasal nerves, the naming of which has been deemed either not complete enough or in other respects not to be fulfilling modern requirements. This remark applies especially to the nasal branch of the Ophthalmic, which in the B.N.A. is called 'Naso-ciliary' up to the point in the orbit of its giving off the Infratrochlear, but which Quain, Gray, Cunningham, and others, have so designated in its entirety as a synonym for the 'Nasal nerve.' There has, however, always been a disposition on the part of some anatomists to describe this nerve as splitting up into branches after its descent through the anterior nasal canal and on this and other points referring to it authors vary considerably.

The map attempts, therefore, to give a clearer conception of the nerve by regarding it as one main stem with branches, from its commencement to its termination, as has already been done, but marked out by natural landmarks into four stages or sections as follows:

1. An 'Orbital' section, extending from immediately behind the sphenoidal fissure to the orbital aperture of the anterior ethmoidal canal: this part corresponds as nearly as may be to the naso-ciliary nerve of the B.N.A., and its situation in the orbit is the origin of its suggested title; it now possesses surgical interest.

2. A 'Cranio-ethmoidal' section, reaching from the anterior ethmoidal foramen to the anterior nasal canal.[1] This stage corresponds practically to the Anterior Ethmoidal nerve of the B.N.A., and the name suggested for it indicates its situation in the cranium, with relations to the ethmoid bone upon which it rests.

3. An 'Intranasal' section, extending from the nasal aperture of the anterior nasal canal to the junction between the nasal bone and the superior lateral cartilage. This stage is included within the part entitled 'Anterior Ethmoidal' nerve in the

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[1] The term 'anterior nasal canal' is here employed to signify the passage through which the Nasal nerve issues from the Cranial cavity to the roof of the Cavum nasi, and which is lateral to the nasal slit or Ethmoidal fissure often mentioned in the textbooks in this connection (consult Quain, vol. iii., part ii., p. 16, and Gray, p. 239).

B.N.A., and in Cunningham's 'Manual,' 1912, edited by Robinson, but it is the 'External branch' of Cunningham's textbook, 1909, and also of Morris's 'Treatise,' edition 1907, in which the B.N.A. is more closely followed. The name 'external branch' has also been retained for this part of the nerve by Gray's editors ever since the first edition in 1858. There are, however, yet other ways of naming it, and the title 'external branch' is applied by some authors to a lateral offset arising from the parent stem as it enters the nasal groove. There seems to be required, therefore, some designation for this stage that will convey the fact of the nerve, now in the nasal fossa, having thus become actually a nasal nerve in accordance with its original title.

4. The fourth and last is the 'Cutaneous section,' extending from the point of escape of the nerve between the bone and cartilage to its ultimate termination on or near the point of the nose.

This continuation of the nasal nerve on the face is still the 'External nasal ramus' of the B.N.A. and in Cunningham's 'Manual,' and the 'Anterior or Superficial' branch of Quain's 'Elements,' as well as of Gerrish's 'Anatomy' (1899); but in the latter the term 'Anterior or Superficial' branch is applied to the nerve higher up—*i.e.*, at the commencement of the previous stage. The simple designation 'cutaneous' for this superficial part is at least expressive of its destination—the skin.

The foregoing arrangement of the Nasal nerve into sections aims at simplification, and sufficiently serves the purpose of the map. The student will therein find the title 'Naso-ciliary' placed under 'Orbital section,' and 'Anterior Ethmoidal' under 'Cranio-ethmoidal section,' thus indicating the equivalents of the sectional titles in the most recent nomenclature; but owing to the greater lack of uniformity in the terminology of the more distal part of the nerve, it has been thought preferable to leave the 'intranasal' and 'cutaneous' sections with no other designations beneath them.

The reader may here be reminded that the B.N.A. authorities consider the nerve they have termed 'naso-ciliary' to divide anteriorly in the orbit into two parts, one constituting the Infratrochlear, and the other the Anterior Ethmoidal. This latter designation, agreeing with that of the canal and companion artery, has not been much adopted; perhaps its popularity would have been more universal had the small 'Posterior Ethmoidal' branch been more constant. It is stated in 'Poirier and Charpy' that Delber found this nerve only twice in six subjects. Readers wishing to consult the 'Traité' by these authors will find the following note upon the French nomenclature useful.

They divide the Frontal into an External Frontal (supra-orbital) and Internal Frontal, which corresponds to the 'Frontal proper' of some of our authors (see Morris's 'Treatise,' 4th ed., p. 964). To the Supratrochlear, which they describe as terminating by anastomosing with the Infratrochlear, they attach the name of Arnold. The Nasal nerve they also divide into two branches (in the orbit)—the External Nasal or Infratrochlear, and Internal Nasal or Ethmoidal, and this divides into an internal branch to the Septum and an external or 'naso-lobar,' their usual designation for the remainder of the nerve.

All further suggestions for a more complete nomenclature of the nasal nerves will be clearly discerned in the map, where they are indicated by italic capitals.

The Superficial nerves of the nose arrange themselves naturally into the following three sets: 'Superior lateral,' 'Inferior lateral' (including vestibular) and 'Anterior or Dorsal cutaneous nasal nerves,' the last-named comprising the cutaneous section and branches of the Nasal nerve just considered.

Turning to the interior or Cavum, the posterior slope of the *roof* at the level of the rostrum of the sphenoid is supplied by a few of the lateral posterior superior nasal nerves which pass *posteriorly* in the muco-periosteum, avoiding the spheno-palatine foramen;[1] the map gives them as from the Vidian, to which alone some authors assign their origin. As these filaments are neither precisely septal, pharyngeal, nor lateral nasal, they are labelled in the map-scheme 'Supreme posterior nasal,' by way of distinction, and owing to their position in the inspiratory breathway, they are probably of considerable importance. The *floor* of the Cavum, and neighbouring wall, receive a nasal branch of the Anterior superior alveolar, its fibres of distribution being labelled 'Anterior inferior meatal nerves.' They are clinically interesting through referring sensory impressions to the canine and incisor teeth. To the anterior part of the *Septum* are distributed the medial branches of the intranasal section of the Nasal nerve, and these are marked 'Anterior Septal Nerves.' The supply for the posterior part of the septum is more complex, the Vidian and medial branches of the Posterior superior nasal furnishing the nerves to the upper and back part, whilst further forward the offsets of the naso-palatine distribute fibrils along the course of the groove on the vomer. The title given to the whole of this group is 'Posterior superior septal nerves.' The *anterior slope* of the roof and the adjoining outer wall of the Cavum nasi are innervated by the lateral branches of the intranasal section of the Nasal nerve, some of which terminate in small filaments for the anterior ends of the middle and inferior turbinates and meatuses; these figure as the 'Anterior Turbinal and Meatal nerves.'

The posterior aspect of the outer wall, as of the corresponding part of the Septum, is supplied from the Maxillary Division, and the nerves range themselves into two groups—a 'Superior' and an 'Inferior' 'Posterior Turbinal and Meatal.' The former group includes the Superior Turbinal and Superior Meatal nerves and the Posterior Middle Turbinal nerve derived from the Spheno-palatine ganglion or from the Vidian; in the map they appear as lateral posterior superior branches of the ganglion. Some writers make no mention of any nasal branches from the Vidian, but it is stated by Robinson[2] that both it and the ganglion contribute to the superior nasal group. The 'Posterior Middle Turbinal' nerve is generally recognized as a constant branch from the lateral set of the posterior superior nasal nerves.

The Inferior group includes the 'Posterior Middle' and 'Posterior Inferior Meatal' and the 'Posterior Inferior Turbinal' nerves; all are branches of the Anterior Palatine.

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[1] See Cunningham's 'Manual,' revised by Robinson, fifth edition, 1912.

[2] *Ibid.*

According to the carefully revised Manual already quoted, which, unfortunately, did not come into the writer's hand until the map was completed, the middle turbinate gets a supply from one of the inferior nasal branches of the Anterior Palatine, as well as from the Lateral posterior superior nasal nerves, and the Inferior Turbinate receives two branches from the Anterior Palatine—viz., part of the superior and the whole of the inferior nasal branch.

These posterior turbinal nerves, owing to the larger area over which they are distributed compared with the anterior, and hence to the greater liability to pathological changes or adverse conditions to which they are subject, may be thought of as the turbinal nerves, so that the prefix 'posterior' is not very essential.

In the following tables and schedules the material dealt with in this Introduction is schematically arranged.

TABLES OF THE ANATOMY AND PHYSIOLOGY OF THE FIFTH NERVE AND ITS CONNECTIONS, CRANIAL AND SYMPATHETIC, WITH INDEX

[APPENDED WILL BE FOUND A TOPOGRAPHICAL SYNOPSIS OF NERVES DISTRIBUTED TO THE NOSE AND ACCESSORY SINUSES AND EXTERNAL AND MIDDLE EAR]

These tables, which are an indispensable accompaniment to the map, contain upwards of 315 named nerves and branches, and are numbered for reference from 1 to 64.

A small figure placed after a component member indicates that such member is further analyzed below.

The general order is that adopted in Quain's 'Elements,' and an asterisk (*) indicates that the branch is omitted or regarded only as a variant in that work or by other authorities.

Thick type indicates that the nerve is a continuation rather than an offset; terminal branches are similarly distinguished. Italic capitals, confined to certain of the nasal nerves, distinguish the extended forms of nomenclature devised by the author for this map. Other details are referred to in the footnotes.

1. Gasserian ganglion …
   - Communicating with carotid plexus (58).
   - To dura.
   - **Ophthalmic** (2).
   - **Maxillary** (11).
   - **Mandibular** (35).
2. Ophthalmic … …
   - Tentorial recurrent (between the layers of the tentorium cerebelli).
   - Communicating with cavernous plexus (59).
   - *To third nerve.
   - To fourth nerve.
   - *To sixth nerve.
   - **Frontal**
     - Supra-orbital (4).
     - Supratrochlear (5).
   - **Lachrymal** (3).
   - **Nasal, or Naso-ciliary** (6).

3. Lachrymal ... ...
   - Communicating with zygomatic.[1]
   - Communicating with facial (50).
   - Glandular to lachrymal gland.
   - Conjunctival.
   - To outer canthus.
   - *Cutaneous to region of external angular process.
4. Supra-orbital .. ...
   - Outer or lateral division
     - Palpebral to upper lid.
     - Communicating with facial.
     - Branches to diploë.
     - To frontal sinus.
     - Branches to pericranium.
     - **Cutaneous to fore and upper part of scalp.**
     - **Cutaneous to parietal region and vertex, nearly to lambdoid suture.**
   - Inner or medial division
     - Palpebral to upper lid.
     - Communicating with facial.
     - Branches to pericranium.
     - **Cutaneous to forehead and parietal region.**
5. Supratrochlear ... ...
   - Palpebral, to inner third of upper lid.
   - Conjunctival.
   - Communicating with infratrochlear.
   - *Cutaneous to root of nose.
   - **Cutaneous branches to lower and middle frontal region.**
6. Naso-ciliary (orbital section of Nasal nerve)... ...
   - Nasal or long root to ciliary ganglion.
   - Long ciliary nerves (two) to ciliary body, cornea, and iris.
   - Infratrochlear (9).
   - Posterior-[2] or spheno-ethmoidal[3] to posterior ethmoidal cells and sphenoidal sinus.
   - **Anterior ethmoidal** (cranio-ethmoidal section of nasal)
     - Branch[4] to anterior ethmoidal cells and frontal sinus (in anterior ethmoidal canal).
     - **Intranasal section of nasal** (7).
7. Intranasal section of Nasal nerve ... ...
   - Lateral branches (turbinal, etc.)
     - To anterior end of middle turbinate and meatus ...
     - To anterior end of inferior turbinate and meatus ... *Anterior turbinal and meatal nerves.*
     - To fore and outer part of wall of fossa.
   - Medial branches (septal)
     - To anterior part of septum, reaching to vestibule ... *Anterior septal nerves.*
     - **Continues as Cutaneous section of nasal.**
8. Cutaneous section of Nasal nerve ... ...
   - Cutaneous to anterior and lower part of nose ... ... *Anterior or dorsal cutaneous nasal nerves.*

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[1] Correctly regarded as a branch of the zygomatic, conveying secretory fibres to lachrymal gland.

[2] Krause.

[3] Luschka.

[4] Meckel and Langenbeck.

9. Infratrochlear ...

- Superior palpebral branch
  - To inner canthus.
  - To inner third of upper lid and conjunctiva.
  - To canaliculi and caruncle.
  - To lachrymal sac.
  - Communicating with supratrochlear.
- Inferior palpebral branch
  - Cutaneous to root of nose ...
  - Cutaneous to upper part of side of nose
    - *Upper lateral cutaneous nasal nerves.*
  - Communicating with infra-orbital.

10. Ciliary ganglion[1] ...

- Roots
  - Sensory (and sympathetic), nasal or long, from naso-ciliary.
  - Motor or short, from third nerve.
  - Sympathetic, from cavernous plexus.
- Branches
  - Short ciliary nerves
    - 1. To tunics of globe.
    - 2. To ciliary body, iris, and cornea.
    - [The short unite with the long ciliary nerves to form the plexus annularis previous to distribution to the last-named organs.]

11. **Maxillary nerve** ...

- Middle meningeal recurrent (12).
- Zygomatic
  - Zygomatico-temporal (13).
  - Zygomatico-facial (14).
- Spheno-palatine (two) to spheno-palatine ganglion (23).
- **Infra-orbital** (15).

12. Middle meningeal recurrent

- To dura.
- To plexus on middle meningeal artery.
- Communicating with spinous recurrent.

13. Zygomatico-temporal ...

- Communicating with lachrymal (secretory).
- Communicating with auriculo-temporal.
- Cutaneous to anterior temporal region and towards orbit.
- Communicating with facial.

14. Zygomatico-facial ...

- Cutaneous to inferior palpebral region.
- Cutaneous to prominence of cheek.
- Communicating with facial.

15. Infra-orbital ...

- Postero-superior alveolar (usually two) (16).
- Middle superior alveolar (17).
- Antero-superior alveolar (18).
- **Facial branches**
  - Inferior palpebral (20).
  - Cutaneous nasal (21).
  - Superior labial (22).

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[1] See also 'Ciliary Ganglion,' in Physiological Analyses.

16. Postero-superior alveolar	External branch	To gums, periosteum, and adjacent lining of cheek.	
	To superior dental plexus	To maxillary sinus.[1] To the molar teeth. Superior gingival.	
17. Middle superior alveolar	To maxillary sinus.[1] Superior gingival. To superior dental plexus and the bicuspid teeth.		
18. Antero-superior alveolar	Nasal branch (19).		
	Dental branch	To superior dental plexus, and to the plexus of the opposite side. To canine. To incisors. Superior gingival. To maxillary sinus.[1]	
19. Nasal branch of Antero-superior alveolar	To anterior part of inferior meatus, including the floor of the nasal fossa		*Antero-inferior meatal nerves.*
	Communicating with naso-palatine.		
20. Inferior palpebral ...	To skin and conjunctiva of lower eyelid. To infra-orbital plexus with facial.		
21. Cutaneous nasal ...	To skin of posterior and lower part of side of nose ... ... Vestibular branch to ala and lining of vestibule		*Lower lateral cutaneous nasal nerves.*
22. Superior labial ...	To skin, mucous membrane, and glands of upper lip and cheek. To infra-orbital plexus with facial.		
23. Spheno-palatine ganglion	Roots	Spheno-palatine nerves (sensory). Vidian, sensory, secretory,[2] and sympathetic.[3]	
	Branches (in groups)	Anterior or orbital (24). Medial or nasal[4] (25). Descending or palatine (26). Posterior (27).	
24. Anterior (ascending) or orbital group	To periosteum of orbit. To sphenoidal sinus. To posterior ethmoidal cells.		
25. Nasal or medial group ...	Postero-superior nasal nerves (28).		

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[1] It is probable that all the alveolar nerves contribute to the supply of the sinus, and that fibres also arise from the superior dental plexus.

[2] See Tables II. and III., p. 19.

[3] See Table IV , p. 20.

[4] Part of these pass posteriorly, and correctly belong to the posterior group (Robinson).

26. Descending or palatine group
- Anterior or great palatine (30).
- Middle palatine (31).
- Posterior palatine (32).

27. Posterior group ... ...
- Branches to muco-periosteum of posterior part of roof of nose and septum, from Vidian or from lateral set of posterior superior nasal nerves.[1] ... ... *Supreme posterior nasal nerves.*
- Pharyngeal or pterygo-palatine (34).

28. Postero-superior nasal nerves
- Lateral set
  - Ethmoidal: To posterior ethmoidal cells.
  - Turbinal
    - Superior turbinal . . ...
    - Superior meatal ... ...
    - Posterior middle turbinal ... *Postero-superior turbinal and meatal nerves.*
- Medial set
  - Branches to upper and posterior part of septum
  - Naso-palatine (29) ... ... *Postero-superior septal nerves.*

29. Naso-palatine nerve ...
- Filaments to septal mucous membrane.
- To mucous membrane behind incisor teeth.
- Communicating with opposite nerve in Scarpa's canal.
- Communicating with anterior superior alveolar.

30. Anterior palatine ... ...
- Inferior nasal branches
  - Posterior middle meatal[2] ... ..
  - Posterior inferior turbinal ...
  - Posterior inferior meatal ... ... *Postero-inferior turbinal and meatal nerves.*
- To inner side of gum, glands, and mucous membrane of hard palate.
- **Communicating with naso-palatine.**

31. Middle palatine ... ...
- To tonsil.
- To glands and mucous membrane of soft palate.

32. Posterior palatine ... ...
- To tonsil.
- To glands and mucous membrane of soft palate.
- To uvula.

33. Vidian ... ...
- **Great superficial petrosal** from geniculate ganglion (51).
- **Great deep petrosal** from internal carotid plexus (conveying fibres from glosso-pharyngeal)[3] (58).
- Sphenoidal branch communicating with otic ganglion.
- Trigeminal fibres to upper and back part of roof and septum of nose, superior turbinate, and meatus.

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[1] See Cunningham's 'Manual,' revised by Robinson, fifth edition, 1912. These small nerves vary, and are difficult to demonstrate.

[2] *Ibid.* Henle and Robinson describe a slightly different arrangement. See Introductory Note.

[3] See Professor Thane's figure in Quain, edition 1909, vol. iii.

34. Pharyngeal ... ...
- To pharyngeal end of Eustachian tube.
- To upper part of pharyngeal wall.
- To naso-pharynx.
- To posterior nares.
- To sphenoidal sinus.

35. **Mandibular nerve** ...
- Internal Pterygoid.
- Spinous recurrent (36).
- **Upper division** (motor, except long buccal) (37).
- **Lower division** (sensory, except mylo-hyoid) (39).

36. Spinous recurrent .. ...
- Communicating with otic ganglion.
- Anterior branch
  - To petrous bone and mastoid cells.
  - Communicating with middle recurrent.
- Posterior branch
  - To great wing of sphenoid.
  - *To dura.

37. Upper division of mandibular
- Anterior deep temporal.
- Middle deep temporal.
- Posterior deep temporal.
- Masseteric.
- External pterygoid.
- Long buccal (purely sensory) (38).

38. Long buccal ... ...
- Branches to buccal plexus with facial.
- Cutaneous to surface of cheek.
- To mucous lining of cheek.

39. Lower division of mandibular
- Auriculo-temporal (40).
- **Lingual** (46).
- **Inferior alveolar** (44).

40. Auriculo-temporal ... ...
- Communicating with otic ganglion (two) (secretory) (49).
- Articular to temporo-maxillary joint.
- Communicating with temporo-facial branch of facial
  - Cutaneous over zygoma.[1]
  - Cutaneous towards angle of mouth.
  - Cutaneous towards chin.
- External auditory meatal (two, superior and inferior) (42).
- Anterior auricular (two, superior and inferior) (43).
- To parotid gland.
- To sympathetic on maxillary artery.
- Communicating with inferior alveolar.
- **Superficial temporal**, with anterior and posterior branches (39).

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[1] Here given as described by Frohse (see Quain, edition 1909).

41. Superficial temporal ...
- **To temporal region, nearly to vertex.**
- Communicating with facial.
- Communicating with zygomatico-temporal.

42. External auditory meatal (two)
- Superior external auditory meatal ...
  - To roof of auditory meatus.
  - To membrana tympani.
- Inferior external auditory meatal ..
  - To anterior wall of auditory meatus.
  - *To lobule of pinna.

43. Anterior auricular (two) ...
- Superior anterior auricular ... ...
  - To ascending limb and crus of helix.
  - To upper part of auricle.
- Inferior anterior auricular ... ...
  - To tragus.

44. Inferior alveolar ... ...
- Motor nerve to mylo-hyoid and anterior belly of digastric.
- Dental branches and plexus
  - Inferior gingival.
  - To molar teeth.
  - To bicuspid teeth.
- **Incisive** ... ...
  - To canine tooth.
  - To incisor teeth
  - Inferior gingival.
- **Mental** (45).

45. Mental ... ...
- Labial branches
  - Cutaneous to lower lip.
  - To mucous membrane of lower lip.
  - To mental plexus with facial.
- Mental branches
  - Cutaneous to region of chin.
  - To mental plexus with facial.

46. Lingual ... ...
- Communicating with inferior alveolar.
- Communicating with facial (pars intermedia) (chorda tympani).
- Branches to the isthmus of the fauces, to tonsil and lining of mouth cavity.
- Communicating with hypoglossal.
- Branches to submaxillary ganglion (47).
- Branches to sublingual ganglion (48).
- **To papillæ of the anterior two-thirds of the tongue.**

47. Submaxillary ganglion ...
- Roots
  - From lingual (chorda tympani) (sensory and secretory).
  - From plexus on external maxillary (facial) artery (sympathetic).
- Branches
  - To floor of mouth and Wharton's duct.
  - To submaxillary gland.
  - *Communicating with hypoglossal.
  - Communicating branches with lingual.

48. *Sublingual ganglion ...
- Roots ... ... From lingual (secretory).
- Branches ... ... To sublingual gland.

49. Otic ganglion ... ...
- Roots
  - Sympathetic from middle meningeal plexus.
  - Motor (and sensory ?) from nerve to internal pterygoid.
  - Secretory from small superficial petrosal.
- Branches
  - Secretory
    - To auriculo-temporal (two).
    - *To long buccal.
  - Communicating
    - With Vidian by sphenoidal branch.[1]
    - ,, nerve to internal pterygoid.
    - ,, chorda tympani.
    - ,, spinous recurrent.
    - ,, nerve to tensor tympani.
    - ,, nerve to tensor palati.[2]

Conclusion of Fifth Nerve and its Ganglia.

Tables 50 to 64 refer to the VIIth, IXth, Xth, Sympathetic and Cervical nerves. These Tables are complete in themselves, but some of the branches in brackets [ ] are necessarily not included in the map scheme.

50. Facial nerve ... ...
- In internal auditory meatus ...
  - *Communicating with auditory nerve.
- At the geniculate ganglion ...
  - Communicating with spheno-palatine ganglion by great superficial petrosal.
  - Communicating with Otic ganglion by branch to join small superficial petrosal.[3]
  - Communicating with Sympathetic on middle meningeal by external superficial petrosal.
- In aqueduct of Fallopius ...
  - Nerve to stapedius.
  - Chorda tympani (sensory and secretory, from pars intermedia).
  - Communicating with auricular of vagus (55).
- At exit from stylo-mastoid foramen ... ...
  - Posterior auricular, with communicating branches to auricular of vagus and superficial cervical nerves.
  - Digastric, with communicating branch to glosso-pharyngeal.
  - [*Communicating with petrous ganglion of IXth.][4]
- Terminal divisions ... ...
  - **Temporo-facial.**
  - **Cervico-facial.**

51. Petrous ganglion of glosso-pharyngeal ... ...
- To superior cervical ganglion through jugular nerve.
- To auricular branch of vagus (54).
- *To ganglion of root of vagus (53).
- Tympanic (nerve of Jacobson) (52).
- **Continued inferiorly as glosso-pharyngeal nerve.**

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[1] According to Rauber's figure, the sphenoidal branch may be a root.

[2] Some authorities believe the motor fibres from the internal pterygoid pass uninterrupted through the otic ganglion to these muscles.

[3] Ramus anastomoticus cum plexu tympanico (B.N.A.).

[4] Attributed to Garibaldi in Landois and Stirling's 'Physiology,' edit. iv., p. 736.

52. Tympanic nerve	To Eustachian tube.	Tympanic plexus.
	To fenestra cochleæ.	
	To fenestra vestibuli.	
	To mastoid cells.	
	To tympanum.	
	Carotico-tympanic[1]	
	Small deep petrosal.[1]	
	Small superficial petrosal.	
53. Ganglion of root of vagus (ganglion jugulare) ...	*Communicating with petrous ganglion of glosso-pharyngeal (51).	
	[With superior cervical ganglion] (57).	
	[With spinal accessory nerve.]	
	Auricular branch (of Arnold) (55).	
	Continued inferiorly to ganglion of trunk (55).	
54. Auricular branch of vagus ...	Communicating with petrous ganglion.	
	Communicating with facial.	
	To membrana tympani.	
	To lower and back part of auditory meatus.	
	Communicating with posterior auricular.	
	Cutaneous to upper and back part of pinna, and external auditory meatus.	
55. Ganglion of trunk of vagus (ganglion nodosum) ...	Pharyngeal branch (to pharyngeal plexus).	
	[Communicating with hypoglossal.]	
	[Communicating with loop between first two cervical.]	
	Superior laryngeal.	
56. Auditory nerve (vestibular division)	*Communicating with facial and pars intermedia in internal auditory meatus	

SYMPATHETIC SYSTEM

57. Superior cervical ganglion ...	**Carotid or ascending**	External division	Internal carotid plexus (58).
		Internal division	Cavernous plexus (59).
	[Grey rami communicating with first four cervical.]		
	[To ganglion of trunk of vagus]		Cranial connections.
	[To hyperglossal (XIIth)]		
	Jugular	To petrous ganglion (IXth)	
		To ganglion of root of vagus (Xth)	
	To pharyngeal plexus.		
	[Vascular rami to external carotid, etc.]		
	Superior cervical cardiac.		
	[**Continued below into middle cervical ganglion.**]		

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[1] Named in the B.N.A. as superior and inferior carotico-tympanic respectively.

58. Internal carotid plexus ...	To internal carotid artery.
	[Communicating with sixth nerve.]
	Communicating with Gasserian ganglion.
	Carotico-tympanic,[1] to tympanic plexus.
	Small deep petrosal (to tympanic plexus).
	Great deep petrosal (to join great superficial petrosal).
	[To cavernous plexus.][2]
59. Cavernous plexus	To internal carotid artery.
	[Communicating with third nerve.]
	[Communicating with fourth.]
	Communicating with ophthalmic of fifth.
	Sympathetic root of ciliary ganglion.
	[Filaments to pituitary body.]

CERVICAL NERVES

CUTANEOUS BRANCHES OF POSTERIOR PRIMARY DIVISIONS FORMING PART OF THE 'POSTERIOR CERVICAL PLEXUS'

60. Great occipital (from second cervical)	To scalp of back of head as far forward as vertex.
	Communicating with small and third occipital.
61. Third occipital (from third cervical)	To scalp of back of head.
	Communicating with great occipital.

ANTERIOR PRIMARY DIVISIONS

CUTANEOUS BRANCHES FORMING THE 'SUPERFICIAL ASCENDING BRANCHES OF THE CERVICAL PLEXUS'

62. Small occipital (from second cervical)	Auricular branch	To skin of upper part of dorsum (medial surface) of pinna.
	Mastoid branch	To skin over mastoid region, communicating with facial.
	Occipital branch	To skin of occipital region.
63. Great auricular (from second and third cervical) .	Facial branch[3] ...	To skin over parotid, masseteric, and buccal regions, and to parotid gland.
	Auricular branch	To skin of lower third of back of pinna.
		Communicating with facial and vagus nerves.
		To skin of front of lobule and helix.
	Mastoid branch	To skin over the mastoid region.
		Communicating with facial.
64. Superficial cervical (from second and third cervical)	Ascending branch	To upper part of front of neck, reaching to mandible.
	Descending branch	To lower part of front of neck, reaching to sternum.

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[1] Often described as arising from the external division of the carotid nerve.

[2] Quain's editors describe the communication as between the external and internal divisions of the carotid branch.

[3] The examinee is often asked to put his finger over the part of his face which is not supplied by the fifth nerve—*i.e.*, the parotid region.

INDEX OF TABLES

(The order of the nerves is that followed in Quain, edition of 1909.)

1. Gasserian ganglion.
2. Ophthalmic nerve.
3. Lachrymal nerve.
4. Supra-orbital nerve.
5. Supratrochlear nerve.
6. Naso-ciliary nerve.
7. Intranasal section of nasal.
8. Cutaneous section of nasal.
9. Infratrochlear nerve.
10. Ciliary ganglion.
11. Maxillary nerve.
12. Middle meningeal recurrent nerve.
13. Zygomatico-temporal nerve.
14. Zygomatico-facial nerve.
15. Infra-orbital nerve.
16. Postero-superior alveolar nerve.
17. Middle superior alveolar nerve.
18. Antero-superior alveolar nerve.
19. Nasal branch of anterior superior alveolar.
20. Inferior palpebral branch of infra-orbital.
21. Cutaneous nasal branch of infra-orbital.
22. Superior labial branch of infra-orbital.
23. Spheno-palatine ganglion.
24. Anterior (ascending) or orbital group.
25. Medial or nasal group.
26. Descending or palatine group.
27. Posterior group.
28. Postero-superior nasal nerves.
29. Naso-palatine nerve.
30. Anterior palatine nerve.
31. Middle palatine nerve.
32. Posterior palatine nerve.
33. Vidian nerve.
34. Pharyngeal nerve.
35. Mandibular nerve.
36. Spinous recurrent nerve.
37. Upper division of mandibular.
38. Long buccal nerve.
39. Lower division of mandibular.
40. Auriculo-temporal nerve.
41. Superficial temporal.
42. External auditory meatal nerves.
43. Anterior auricular nerves.
44. Inferior alveolar nerve.
45. Mental nerve.
46. Lingual nerve.
47. Submaxillary ganglion.
48. Sublingual ganglion.
49. Otic ganglion.
50. Facial nerve.
51. Petrous ganglion of glosso-pharyngeal.
52. Tympanic nerve.
53. Ganglion of root of vagus.
54. Auricular branch of vagus.
55. Ganglion of trunk of vagus.
56. Auditory nerve (vestibular division).
57. Superior cervical ganglion.
58. Internal carotid plexus.
59. Cavernous plexus.
60. Great occipital nerve.
61. Third occipital nerve.
62. Small occipital nerve.
63. Great auricular nerve.
64. Superficial or transverse cervical nerve.

PHYSIOLOGICAL ANALYSES

I. CILIARY GANGLION

TABLE OF DISTRIBUTION AND FUNCTIONS OF THE LONG AND SHORT CILIARY NERVES

1. Trigeminal fibres in nasal root, and long ciliary nerves ...	Sensory to tunics of globe, ciliary body, cornea, and iris.
2. Sympathetic fibres from cavernous plexus conveyed by ophthalmic, and nasal root	Dilator fibres to pupil. Vaso-dilator fibres to vessels of globe.
3. Sympathetic fibres passing to the globe from cavernous plexus directly	Motor fibres to Müller's muscle (non-striated fibres of levator palpebræ). Vaso-constrictor fibres to vessels of globe.
4. Fibres of third nerve passing directly to the ciliary ganglion, but interrupted in it[1]	Motor fibres to sphincters of pupil and ciliary muscle.

II. ANALYSIS OF THE CONNECTIONS OF THE FIFTH NERVE WITH THE PARS INTERMEDIA (SENSORY PART OF THE FACIAL)

Note.—The map shows that the pars intermedia gains access to the ophthalmic nerve through one connection only—viz., the loop of anastomosis between the lachrymal and zygomatic nerves, the fibres being conveyed by the great superficial petrosal to the spheno-palatine ganglion.

The first division of the fifth is thus supplied through the second, the current ascending by the spheno-palatine nerves, and taking a reflected course to reach the maxillary nerve and its zygomatic branch.

The third, or mandibular division is connected with the pars intermedia through the chorda tympani—first, by a filament from the chorda to the otic ganglion, and secondly, by direct fusion with the lingual.

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[1] The fibres in Nos. 1, 2, and 3 are believed to pass uninterrupted through the ciliary ganglion.

There is also the anastomotic ramus from the geniculate ganglion to the small superficial petrosal or to the tympanic plexus (according to how it is regarded), the former being the French, the latter the German view.[1]

These facts may be restated as follows :

Pars intermedia	Through great superficial petrosal and Vidian to spheno-palatine ganglion	Secretory and vaso-dilator	To lachrymal gland. To racemose nasal glands. To glands of soft palate.
	Through chorda tympani, accompanying lingual	Gustatory fibres to anterior two-thirds of tongue.	
		Secretory and vaso-dilator fibres	To submaxillary gland. To sublingual gland. To glands of floor of mouth.
	Through chorda by way of long buccal nerve to otic ganglion (?)	? Secretory and vaso-dilator to glands of lining of cheek.	

III. CONNECTIONS BETWEEN THE FIFTH NERVE AND THE GLOSSO-PHARYNGEAL

Note.—The chief communication is through the tympanic nerve.

With the *second* division of the fifth the tympanic is connected through the carotico-tympanic and small deep petrosal nerves, which, after uniting with the carotid plexus, convey fibres to the great deep petrosal, and thus reach the spheno-palatine ganglion ; or the small deep petrosal may join directly with one of the large petrosals (Quain, vol. iii., part ii., p. 39).

A constant and important connection with the *third* division is formed by the continuation of the tympanic nerve as the small superficial petrosal to the otic ganglion. The path is here probably interrupted, and continued along two small filaments to the auriculo-temporal, whence the fibres reach their destination in the parotid gland.

Glosso-pharyngeal	With second division of fifth	By tympanic, small deep petrosal, great deep petrosal and Vidian to spheno-palatine ganglion	Vaso-dilator and secretory fibres.
	With third division of fifth	By tympanic and small superficial petrosal to auriculo-temporal through otic ganglion	Vaso-dilator and secretory fibres to parotid gland.

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[1] The fibres in this branch are said not to appear to be connected with the cells of the geniculate ganglion (Morris's 'Treatise,' edit iv)

IV. CONNECTIONS BETWEEN THE FIFTH NERVE AND THE SYMPATHETIC SYSTEM

Note.—No pre-Gasserian connection is represented between the sympathetic and the fifth nerve. The prime source figured in the map is the superior cervical ganglion; anastomosis between the carotid plexus and the basal surface of the ganglion is presumed to exist, but is not universally recognized. (See Quain's 'Elements,' vol. iii., part ii., p. 154.)

Sympathetic fibres enter the ophthalmic nerve previous to its subdivision, directly from the cavernous plexus, and the ciliary ganglion is usually joined from the same source by a separate root, though the nasal root of the fifth, or the motor root of the third, may take its place. The lachrymal secretion is said to be influenced by the sympathetic; if so, it is either through the ophthalmic, or the vascular plexuses.

To the second division the sympathetic is conveyed directly by the great deep petrosal from the carotid plexus. Arriving with the Vidian at the spheno-palatine ganglion, the path is interrupted, and fresh neurones carry the impulses to their destination *via* the nasal and palatine nerves.

Between the third division of the fifth and the sympathetic there is no direct anastomosis, and the otic and submaxillary ganglia are supplied through the plexuses on the middle meningeal and facial arteries respectively.

Superior cervical ganglion ...	From cavernous plexus ...	To the ophthalmic ...	Vaso-constrictor and secretory fibres to lachrymal gland.
		To the ciliary ganglion ...	Vaso-motor to the globe of the eye.
	From carotid plexus ...	Through great deep petrosal by Vidian to spheno-palatine ganglion	Vaso-motor fibres to nasal vascular sinuses, controlling erectile tumefaction of Schneiderian membrane.
			Secretory to nasal mucous glands and to glands of soft palate.
	From middle meningeal plexus	To otic ganglion	Vaso-constrictor and secretory to glands of buccal region.
	From facial plexus ...	To parotid gland, submaxillary and sublingual ganglia	Vaso-constrictor and secretory to parotid, submaxillary, and sublingual glands.

SYNOPSIS OF TRIGEMINAL BRANCHES DISTRIBUTED TO THE NOSE AND ACCESSORY SINUSES

THE NOSE

N.B.—The region is given in left-hand column.

The nerves supplying the region, indicating when possible the terminology of the B.N.A., appear in the centre.

Extended titles for nasal nerves or groups suggested by the author are given in the right-hand column.

I. NASAL CUTANEOUS BRANCHES

1. Root and upper part of side of nose	*1. Supratrochlear 2. Inferior palpebral branch of infratrochlear	*Upper lateral cutaneous nasal nerves.*
2. Posterior and lower part of side of nose, including the vestibule	Internal nasal, from facial branches of infra-orbital	*Lower lateral cutaneous nasal (and vestibular) nerves.*
3. Dorsum and point of nose	External nasal ramus of anterior ethmoidal	*Anterior or dorsal cutaneous nasal nerves.*

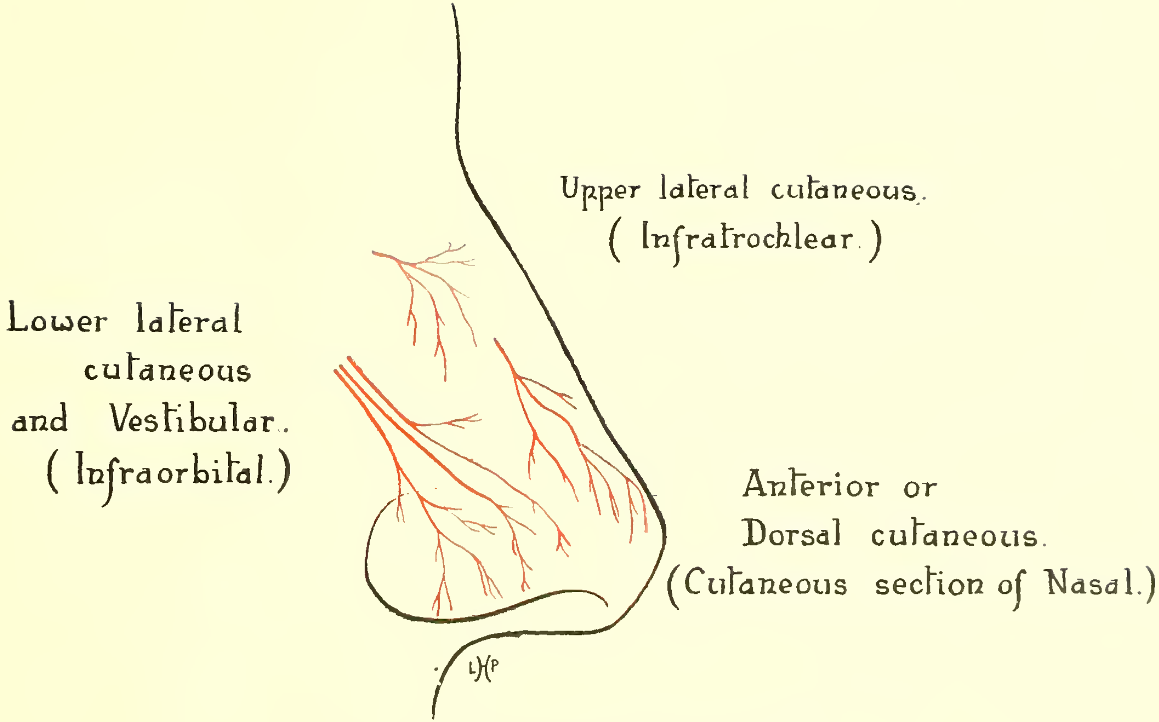
Upper lateral cutaneous.
(Infratrochlear.)
Lower lateral cutaneous and Vestibular.
(Infraorbital.)
Anterior or Dorsal cutaneous.
(Cutaneous section of Nasal.)
LHP

FIG. 1.—CUTANEOUS NERVES OF THE NOSE.

II. SEPTUM NASI

1. Upper and anterior aspect of septum, reaching as far down as vestibule	Medial branches of anterior ethmoidal	*Anterior septal nerves.*
2. The highest part of the septum posteriorly, and adjacent part of the roof, are supplied by the Vidian and some lateral branches of the posterior superior nasal that do not pass through the spheno-palatine foramen		*Supreme posterior nasal nerves.*
3. Posterior and upper part of septum and region of the groove	Medial branches of posterior superior nasal nerves from spheno-palatine ganglion and Vidian, and septal offsets of naso-palatine	*Postero-superior septal nerves.*

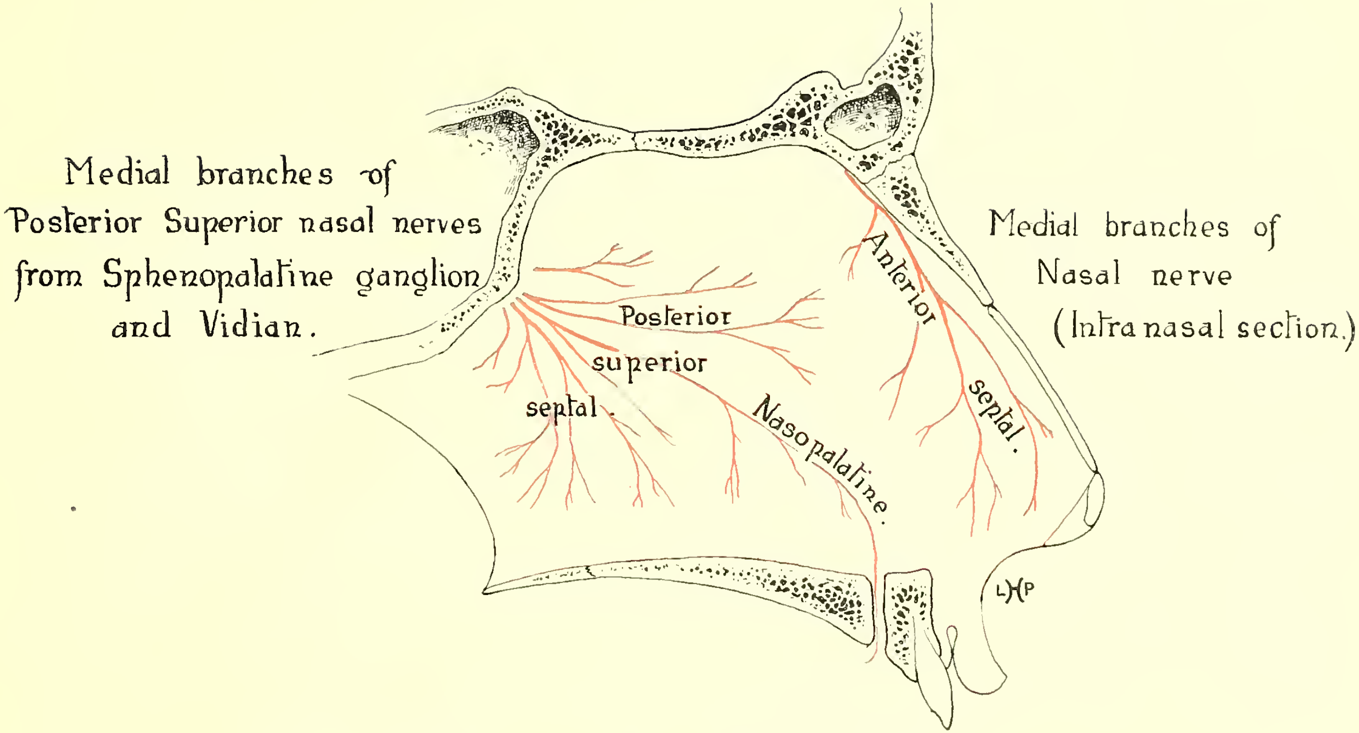
Medial branches of Posterior Superior nasal nerves from Sphenopalatine ganglion and Vidian.
Posterior
superior
septal.
Nasopalatine.
Anterior
septal.
Medial branches of Nasal nerve (Intra nasal section.)
L)(P

FIG. 2.—TRIGEMINAL NERVES OF SEPTAL WALL.

III. TURBINATE BODIES

1. Superior turbinate and posterior two-thirds of middle turbinate	Lateral branches of postero-superior nasal nerves from spheno-palatine ganglion and Vidian	*Superior turbinal nerve* *Posterior middle turbinal nerve*	*Postero-superior turbinal and meatal nerves.*
2. Posterior two-thirds of inferior turbinate	Lateral posterior inferior nasal branch of anterior palatine	*Posterior inferior turbinal nerve*	*Inferior turbinal and meatal nerves.*
3. Anterior extremity of middle and inferior turbinates (including adjacent outer wall of fossa)	Lateral branches of anterior ethmoidal		*Anterior turbinal and meatal nerves.*

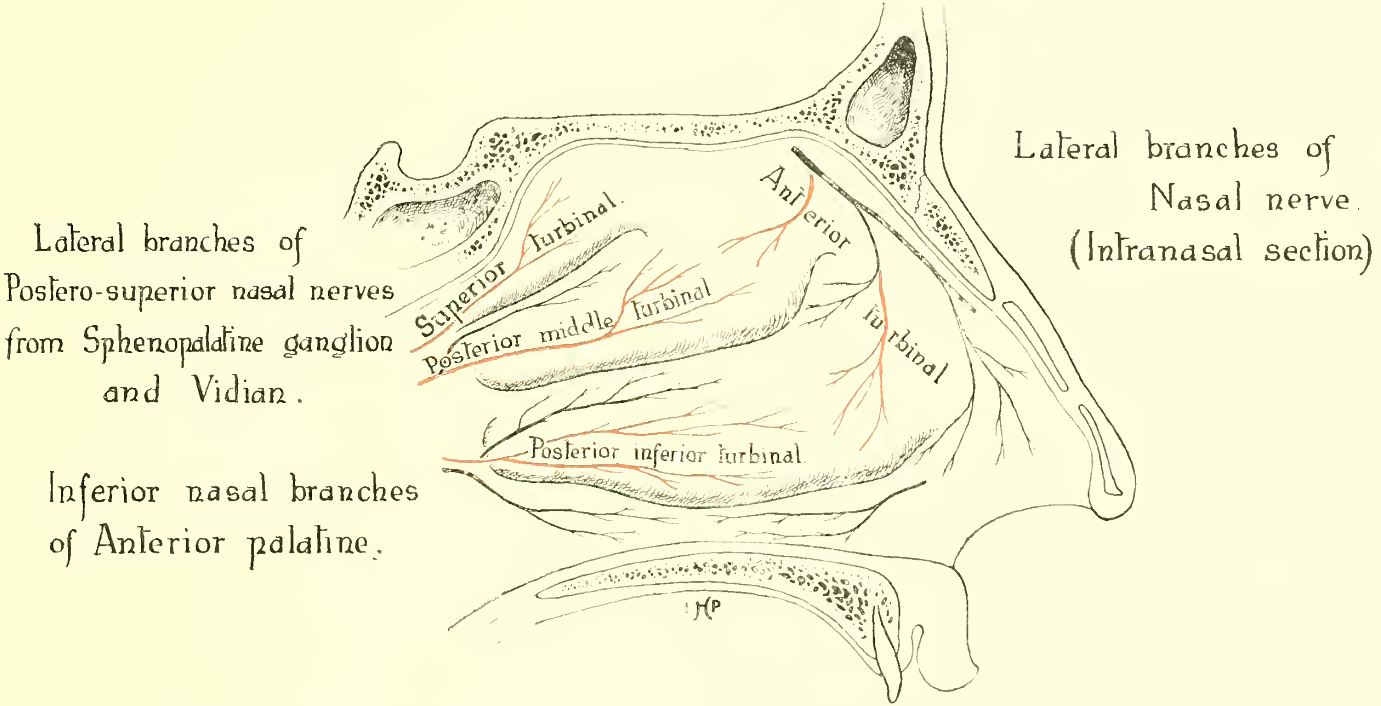

FIG. 3.—TRIGEMINAL NERVES OF LATERAL NASAL WALL. (*Diagrammatic*) TURBINAL NERVES.

The turbinal branches are printed red, the meatal, black.

IV. NASAL MEATUSES

1. Posterior part of middle and inferior meatuses	Lateral posterior inferior nasal branches of anterior palatine[1]	*Posterior middle and postero-inferior meatal nerves.*
2. Anterior part of inferior meatus and floor of fossa	Nasal branch of anterior superior alveolar Lateral branch of anterior ethmoidal nerve	*Anterior meatal and antero-inferior meatal nerves.*
3. Superior meatus	Lateral posterior superior nasal branches from spheno-palatine ganglion and Vidian	*Posterior superior turbinal and meatal nerves.*

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[1] See footnote at bottom of p. 11.

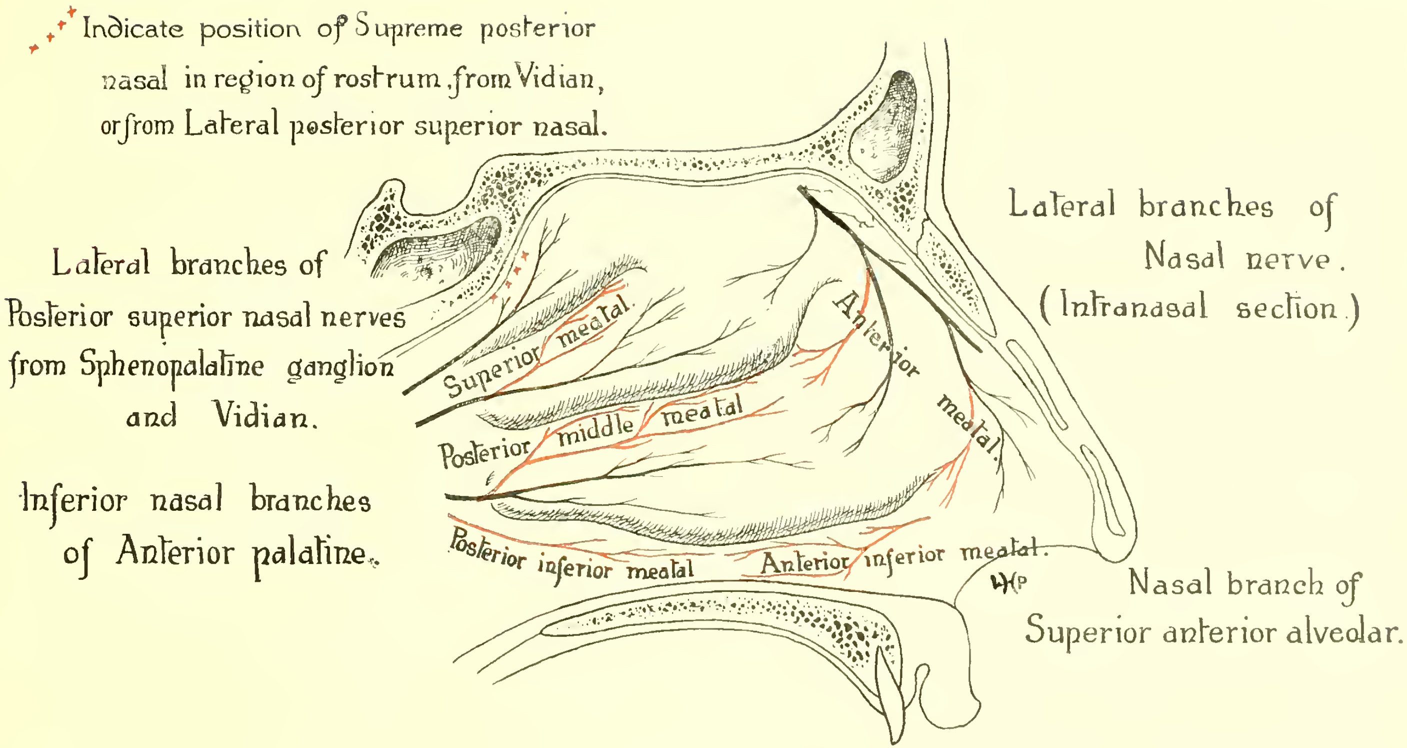
+ + + + Indicate position of Supreme posterior nasal in region of rostrum, from Vidian, or from Lateral posterior superior nasal.
Lateral branches of Posterior superior nasal nerves from Sphenopalatine ganglion and Vidian.
Inferior nasal branches of Anterior palatine.
Lateral branches of Nasal nerve. (Intranasal section.)
Nasal branch of Superior anterior alveolar.
Superior meatal.
Posterior middle meatal
Anterior meatal.
Posterior inferior meatal
Anterior inferior meatal.
WKP

FIG. 4.—TRIGEMINAL NERVES OF LATERAL NASAL WALL AND ROOF. (*Diagrammatic*) MEATAL NERVES.

The meatal branches are printed red, the turbinate, black.

THE ACCESSORY SINUSES

1. Frontal sinus ...	Frontal sinus branch of supra-orbital. Occasional branch from anterior ethmoidal in passing through anterior ethmoidal canal.
2. Posterior ethmoidal cells	Ethmoidal nerves from orbital branches of spheno-palatine ganglion. Ethmoidal branches of posterior superior nasal nerves from spheno-palatine ganglion. Occasional branch from anterior ethmoidal in anterior ethmoidal canal. Occasional 'posterior ethmoidal' nerve, a branch of naso-ciliary; (passes through posterior ethmoida canal).
3. Sphenoidal sinus ...	Sphenoidal nerves from orbital branches of spheno-palatine ganglion. Sphenoidal nerves from pharyngeal of spheno-palatine ganglion. Sphenoidal nerves from 'posterior' or 'spheno-ethmoidal' branch of naso-ciliary.
4. Maxillary sinus ...	Maxillary sinus branches of anterior, middle, and posterior alveolar nerves from superior maxillary. Branches from superior dental plexus of superior maxillary.

SENSORY NERVES DISTRIBUTED TO THE EXTERNAL EAR

I. LATERAL OR EXTERNAL SURFACE OF AURICLE

1. To the upper, anterior, and lesser part of auricle; to crus and ascending limb of helix	Superior anterior auricular branch of auriculo-temporal.
2. To tragus	Inferior anterior auricular branch of auriculo-temporal.
3. To lower, posterior, and greater part of auricle, behind a line from upper part of helix to centre of fissura intertragica	Auricular branch of great auricular from cervical plexus.
4. To part of hollow of concha	Terminal branch of auricular branch of vagus.

II. MEDIAL OR CRANIAL SURFACE OF AURICLE

1. To upper third or fourth of medial surface	Auricular branch of small occipital from cervical plexus (superiorly). Cutaneous termination of auricular branch of vagus (inferiorly).
2. Lower three-fourths of medial surface	Auricular branch of great auricular from cervical plexus.

III. EXTERNAL AUDITORY MEATUS

1. Roof of meatus	Superior external auditory meatal branch of auriculo-temporal.
2. Anterior part of meatus	Inferior external auditory meatal branch of auriculo-temporal.
3. Lower posterior part of meatus	Auricular branch of vagus.

IV. MOTOR AND SENSORY NERVES TO MIDDLE EAR

1. To membrana tympani	Auricular branch of vagus. Superior external auditory meatal branch of auriculo-temporal.
2. To tympanic mucous membrane; to fenestra cochleæ and fenestra vestibuli	Tympanic nerve (Jacobson's) from glosso-pharyngeal.
3. To Eustachian tube	Filament from tympanic nerve. Filament from pharyngeal branch of spheno-palatine ganglion. Branch from trigeminal fibres, conveyed by Vidian from spheno-palatine ganglion.
4. To tensor tympani muscle	Branch from nerve to internal pterygoid of Vth through otic ganglion.
5. To stapedius	Branch from facial in aqueduct of Fallopius.
6. To mastoid cells	Branch from tympanic nerve (IXth). Filaments from anterior branch of spinous recurrent (Vth).

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